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Intra-Aortic Balloon Counterpulsation Improves Regional Systolic Function After Acute Myocardial Infarction: Randomized Experimental Magnetic Resonance Imaging Study

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**Background:** We investigated whether the favorable shift in the myocardial oxygen supply/demand ratio afforded by intraaortic balloon counterpulsation (IABP) translates into improved regional systolic function after acute myocardial infarction (AMI). **Methods:** Fourteen dogs underwent 90-min coronary artery occlusion and reperfusion. Seven were randomized to IABP immediately after reperfusion. Five short-axis slices were acquired for each dog at 1h, 6h and 24h following reperfusion using both delayed-enhancement (DE) and tagged MRI. IABP was paused during image acquisition. The risk region was defined as regional blood flow <50% of remote by radioactive microspheres. Each slice was divided into 6 segments that were classified in 4 categories: transmural AMI (DE>50% area), subendocardial AMI (DE<50% area), risk region and remote area. Peak systolic circumferential strain (Ecc) was calculated for each segment. **Results:** Among segments with transmural AMI there was no difference in Ecc between the IABP group and controls (1±3% vs 1±3% at 1h, 0±4% vs 0±3% at 6h and 0±3% vs 0±3% at 24h, NS for all) and no Ecc improvement over time. Among subendocardial AMI segments, at 24h after reperfusion, the IABP group exhibited higher Ecc values than controls (-2±4% vs -3±3% at 1h, NS, -2±4% vs -2±4% at 6h, NS and -6±3% vs -4±3%, P<0.01), and only the IABP group had a significant improvement in Ecc from 1h or 6h to 24h (P<0.001). Among risk region segments, both groups displayed significant systolic dysfunction at 1h, and recovered normal contractility at 24h. At 6h, however, the IABP group exhibited normal contractility while controls still displayed systolic dysfunction (-5±4% vs -5±3% at 1h, NS, -12±5% vs -6±3% at 6h, P<0.001 and -14±5% vs -13±4% at 24h, NS). Therefore, both groups showed a significant Ecc improvement over time in risk regions, but the improvement occurred earlier in the IABP group. Both groups displayed normal Ecc values in remote segments at all times (-13±5% vs -12±5% at 1h, -14±6% vs -13±5% at 6h, and -13±5% vs -13±5% at 24h, NS for all). **Conclusion:** IABP has a direct beneficial effect on regional functional recovery of segments that are predominantly composed of stunned myocardium after reperfused AMI.

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Steady State Free Precession Perfusion Allows Visual Assessment for the Clinical Diagnosis of Ischemia

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Cardiac magnetic resonance imaging (MRI) is a powerful tool for the non-invasive examination of myocardial perfusion. Apart from the determination of wall motion the assessment of coronary perfusion at rest and during pharmacological stress is a very reliable method for the detection of myocardial ischemia. Semi quantitative analysis (assessment of the myocardial signal up-slope and the response of blood supply to stress) is too elaborate for the use in clinical routine. However, conventional techniques are hampered by artifacts and a poor signal-to-noise-ratio impeding visual assessment. Steady-state-free-precession (SSFP) sequences are a new technique with a better spatial resolution. The aim of this study was to assess diagnostic accuracy of SSFP. **Methods:** 137 patients (mean 61 years, 85% male) with suspected coronary heart disease or suspected progression were examined by cardiac MRI (1.5T Philips Intera CV). All patients underwent coronary angiography. For the assessment of myocardial perfusion a SSFP-sequence with a slice selective saturation-recovery-prepulse (3 slice-coverage of left ventricle per heartbeat) was employed and pharmacological stress was performed by using adenosine(140µg/kg/min). The analysis was performed without knowledge of the angiographic findings. **Results:** 85 of 94 patients with significant stenosis (>70% diameter stenosis) in invasive angiography showed stress related attenuated perfusion in MRI indicating ischemia (sensitivity 90%). Only 5 out of 38 patients with no significant stenosis in coronary angiography showed attenuated appearance of contrast in MRI (specificity 88%). Among those 2 patients had hypertonia , 2 patients showed pathological exercise testing and 1 patient had no stenosis although presenting 2 lesions in scar imaging. 5/85 patients with a visible perfusion defect in MRI showed no relevant stenosis in angiography (positive correctness 94%). 9/38 patients with no attenuated perfusion in MRI showed a significant stenosis in coronary angiography (negative correctness 81%). **Conclusion:** SSFP-sequences with visual assessment of perfusion defects allow a reliable detection of relevant myocardial ischemia from cardiac MRI.

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Gadolinium-Enhanced Magnetic Resonance Imaging in Patients With Left Ventricular Apical Ballooning Syndrome Identifies Acute Myocarditis as a Potential Etiology of This Syndrome

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**Background:** Gadolinium-enhanced cardiac MRI (Gd-MRI) is a new non-invasive diagnostic tool to identify patients with acute myocarditis. Left ventricular apical ballooning syndrome (LVABS) is a clinical condition of unknown etiology characterized by acute onset of abnormal apical wall motion in the presence of angiographically normal coronary arteries. To test the hypothesis that acute myocarditis may be the etiology of this syndrome, Gd-MRI was performed as described by Friedrich et al (Circulation 1998;97:1802) in 11 consecutive patients who presented to Massachusetts General Hospital between January 2000 and January 2002 with LVABS. **Methods.** The ratio of global enhancement of myocardium relative to skeletal muscle was calculated from T1-

weighted spin-echo images acquired before and after administration of 0.1mmol/kg of Gd intravenously. The Gd-MRI study was considered positive for myocarditis when this ratio was > 3.5. Because myocarditis can be a focal disease, we also calculated a regional relative enhancement ratio (RRER) within the area of abnormal wall motion. **Results.** All patients were female (mean age of 72 ± 11 years) who presented with acute onset of chest pain, ST segment elevation, extensive anterior and apical wall motion abnormalities, elevated cardiac enzymes and angiographically normal coronary arteries. Global MRI analysis was positive for myocarditis in 5/11 patients (45.5%, mean value of 4.8 ± 1.4 at 5 ± 2 days after admission). Regional MRI analysis identified 4 additional patients with myocarditis (mean RRER 4.1 ± 0.6). The mean left ventricular ejection fraction was 41 ± 12% at the time of admission, 52 ± 14% at the time of hospital discharge, and 70.2 ± 8% at 39 ± 43 days of follow-up. **Conclusion:** 1) LVABS is characterized by acute onset of chest pain associated with abnormal apical wall motion and myonecrosis in the presence of normal coronary arteries, followed by rapid improvement in LV systolic function. 2) Gd-MRI suggests that acute myocarditis is a possible underlying mechanism for the LVABS. 3) Because myocarditis can be a focal disease, regional Gd-MRI analysis adds sensitivity to global Gd-MRI analysis in this cohort of patients.

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Usefulness of Myocardial Delayed Enhancement Magnetic Resonance in the Diagnosis and Surgical Treatment of Endomyocardial Fibrosis

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**Background:** Endomyocardial fibrosis (EMF) is a rare restrictive cardiomyopathy, whose differential diagnosis includes cardiac diseases with apical obliteration. The treatment is fibrous tissue (FT) resection in symptomatic patients (pts). Myocardial delayed enhancement (MDE) magnetic resonance with gadolinium-based contrast (Gd) allows the detection of myocardial injury and fibrosis. Therefore, the aim of this study was to analyze the utility of MDE in patients with EMF. **Methods:** We studied prospectively 24 pts (19 females, 58±11 years) with EMF, 4 (17%) with predominant right ventricular (RV) involvement, 12 (50%) with predominant left ventricular (LV) involvement and 8 (33%) with biventricular involvement. Six (25%) of these pts were submitted to resection of LV fibrosis and were analyzed by MDE pre- and post-operatively. MDE were performed in a 1.5TGE CV/I magnetic. Images were acquired after 10-20 minutes of 0.2 mmol/kg of Gd bolus. We analyzed % LV FT (%FT)= LV FT/LV mass. **Results:** All surgical cases were confirmed as EMF during surgery and by pathology. Data are shown in Table 1. Postsurgical LV fibrosis decreased significantly (Table 1 \*p<0.05, pre- vs. postsurgical). **Conclusions:** MDE is useful to confirm the diagnosis of EMF by differentiating from apical thrombus, hypertrophy and tumor. MDE was able to detect and quantify the fibrous tissue in both ventricles pre- and postoperatively. Moreover, this technique provides the precise location of fibrous tissue crucial for surgical planning.

Table I

Variable	RV fibrotic mass (g)	LV fibrotic mass (g)	% LV fibrotic mass (%)
LV EMF (n=12)	-	16±7	13±7
RV EMF (n=4)	13±12	-	-
Biventricular EMF (n=8)	12±9	22±14	17±8
Pre- (n=6)	-	19±6*	25±7*
Post- (n=6)	-	14±3*	11±3*

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Cardiac Magnetic Resonance Imaging in the Diagnosis of Sarcoidosis

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**Background:** Sarcoidosis has been reported to cause clinical symptoms due to cardiac infiltration in 5% of patients. Postmortem studies have revealed cardiac involvement in 20-50% of cases. Echocardiography, myocardial scintigraphy and myocardial biopsy suffer from low sensitivity, specificity or both. Cardiac magnetic resonance (CMR) imaging might be a valuable technique in the diagnosis of this condition. We prospectively evaluated CMR findings in patients with various stages of sarcoidosis, and determined sensitivity and specificity as compared to the guidelines from the Japanese Ministry of Health and Welfare (1993) for the diagnosis of cardiac sarcoidosis (gold standard). **Methods:** Breath-hold functional gradient echo, T1-weighted multislice CMR examinations acquired at 1.5 T with ECG-triggering were performed before and 10 minutes after the administration of 0.1 mmol/kg Gd-DTPA in 78 patients with various stages of sarcoidosis. Ventricular function, regional wall motion, wall thickness, and the presence and localization of Gd-enhanced lesions were assessed by two blinded observers. Additional evaluation included physical examination, 12 lead ECG, 24-hour Holter ECG, echocardiography, thallium-201 scintigraphy and coronary angiography, if coronary disease was suspected. The outcomes of the CMR studies were compared with the gold standard for the diagnosis of cardiac sarcoidosis. **Results:** 78 patients (50 male, 28 female, mean age 46,1 years, range 29-72 years) with different stages of sarcoidosis (stage 0: 17, stage 1: 21, stage 2: 10, stage 3: 22, stage 4: 8) underwent diagnostic testing. 5 CMR studies were of insufficient image quality. In 8 patients (11%) the diagnosis of cardiac sarcoidosis was made according to the gold standard. In 6/8 patients CMR both observers found Gd-enhanced lesions with/without